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# **An Examination of the Relationship Between Environmental Practices and Firm Performance**

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**Abstract:** Data concerning EP and firm performance from 45 "environmentally conscious" firms were gathered from their corporate annual reports. Content analysis and set correlation analysis were performed to explore the relationships between a set of EPs and a set of performance measures. Results indicate EPs have significant impacts on firm performance.

## **INTRODUCTION**

Recently, there has been a great deal of interest in the research literature regarding how environmental practices (EPs) can improve firm performance. According to Rondinelli and Vastag (1995), firms may have been reacting to an increasingly difficult regulatory environment or responding to market pressure. Either way, the responses of firms to environmental pressures has led to practices that impact profitability. Currently, more firms are trying to understand the benefits of a proactive approach to environmental policies. Some firms may be motivated to become environmentally proactive since it could lead to more efficient use of resources and improve corporate image. Despite this intuitive argument, many firms are reluctant to take a more aggressive and proactive approach to EPs, due to a dearth of evidence that benefits exceed the costs of pursuing these initiatives. This attitude is attested to by the relatively low number of ISO 14000 certifications that have been issued to U.S. firms (NIST 1998, ISO 2001).

Despite the prevailing reactive stance of firms to EPs, it is increasingly important to take notice of EPs for their own benefits. The evidence in both literature and experiences of firms would suggest that EPs are becoming popular due to the release of voluntary and international environmental standards. The ISO 14001 standard was released in the Fall of 1996 and since then there has been additional pressure on some industry supply chains to address environmental performance through the use of environmental management systems. Selecting meaningful and effective tools for measuring environmental performance is also becoming increasingly important due the increasing costs of environmental options, and compliance with regulatory and public pressures (Kleiner 1991; Barrett 1992; Stern 1991; Porter and van der Linde 1995). Other voluntary environmental initiatives, such as the International Chamber of Commerce Business Principles for Sustainable Development have prompted firms to take actions in recent years (GEMI, 1997). The release of these new standards and voluntary programs presents an impetus for practitioners to better understand the dynamic environment in which they operate and is one reason for researchers to investigate the relationship between EPs and firm performance.

After a review of the literature to date on EPs, we found that there is only a limited amount of research which is primarily focused on defining EPs and on how these practices impact a firm's performance. The principal objectives of this paper are to formally define EPs, integrate the existing EP measures in literature, and empirically examine the relationship between EPs and firm performance.

## **LITERATURE REVIEW**

Most of the conceptual articles in the literature to date fall into two camps: those that agree with Porter's (Porter 1991, with van der Linde 1995) opinion that there is a "win-win" situation with relation to environmental management efforts, and those that argue that the cost/benefit tradeoffs of environmental management must be evaluated, if not outright rejecting any possible benefits from environmental management. Research in this evolving field has been limited. Most of the empirical research to date has presented a positive relationship between EPs and various measures of firm performance. Literature with two competing perspectives and their empirical evidence are reviewed in the following sections.

### **Win-Win Arguments**

Porter's (1991) "win-win" argument was among the first in the literature to challenge the conventional wisdom that government environmental standards are harmful to the competitiveness of firms. Porter argued that the benefits of environmental management are larger than the costs and tighter regulatory standards will in fact lead to innovation. Porter and van der Linde (1995)

continued this line of argument by discussing the idea of “innovation offsets”. Their argument was that environmental regulations can actually lead to innovations and the resulting benefits may offset the cost of complying with the regulations. Thus, firms should view environmental regulations as a means of inspiring innovative thinking. The authors present anecdotal evidence to bolster their case. These two articles are particularly important to the environmental management research stream due to the fact that they elicited a great deal of interest in this topic. However, it should be recognized that these articles only focused on environmental regulation, which is just one aspect of environmental management.

Porter and van der Linde’s argument refers specifically to government environmental regulation as being the impetus for innovation, while many other authors argue more broadly for the benefits of proactive environmental management. Hanna and Newman (1995) provided a summary of arguments in favor of win-win scenarios. Royston (1980), Bonifant (1994), or Bonifant and Ratcliff (1994) have offered similar arguments. Sanchez (1997) has also discussed innovation and environmental regulations. The author argued that managers could influence the effect of environmental regulation on their firm’s tendency to innovate. This argument may be considered parallel to Porter and van der Linde’s (1995) argument that regulation can actually spur innovation, if the regulation is created properly.

More rigorous empirical tests of the relationship between EPs and firm performance can be found in Klassen and McLaughlin (1996) and Russo and Fouts (1997). Klassen and McLaughlin used an event study to look at how the announcement of a third party environmental award affected a firm’s stock market return. This research explored “the orientation of management toward environmental performance”. The authors did not operationalize environmental practices into specific practices from which a firm could choose. Instead, Klassen and McLaughlin used event history analysis to show a positive relationship between EPs and firm performance, an apparent confirmation of the “win-win” argument. Russo and Fouts (1997), using the resource-based view of the firm, linked environmental performance to economic performance through an analysis of 243 firms, using independently developed environmental ratings. These authors noted that this relationship is moderated by the growth of the industry. Their results indicated that it “pays to be green” and the relationship is reinforced with the existence of industry growth.

Klassen and Whybark (2000a) also used the resource-based view of the firm as a theoretical underpinning to explore the link between an environmental technology portfolio and manufacturing performance. The EPs used in their research, focus primarily on manufacturing technologies and operational performance measures. More recently, Klassen and Whybark (2000b) developed a model of environmental management and operations that again link environmental performance and toxic release outputs with operations performance.

## **Trade-Off Perspectives**

Those who ascribe to the “trade-off” perspective disagree with the idea that environmental practices could have a broader impact other than environmental performance. Walley and Whitehead (1994) were among the first to argue for the existence of a “trade-off zone”, where environmental benefits were weighed against potential value destruction. They discussed this trade-off in terms of operational, tactical, and strategic EPs in the context of arguing against Porter and van der Linde. Walley and Whitehead’s argument was focused almost exclusively on cost versus benefit. This was a conceptual article that lacked empirical testing of propositions.

Palmer, Oates, and Portney (1995) attempted such a test, by reviewing statistics from the U.S. Department of Commerce. They concluded that the costs of pollution abatement and control far exceeded the offsets claimed by Porter and van der Linde. Jaffe, Peterson, Portney and Stavins (1995) attempted a similar review of economic statistics and reached much the same conclusion. This type of analysis dates back to at least 1974, when The Conference Board found that the majority of companies treated environmental management as a threat, noting “a widespread tendency in most of industry to treat pollution control expenditures as non-recoverable investments” (Lund 1974).

In general, there has been limited but growing empirical research in the environmental management field. The empirical papers that exist represent diverse opinions as to the effect of EP on firm performance. The literature that supports the win-win hypothesis tends to take a narrow view of EPs in that it has tended to focus on a smaller subset of EPs, with some papers focusing on waste reduction, some on manufacturing and remanufacturing techniques, and yet others on product design. In order to further the discussion of the relationship between EPs and firm performance, it is necessary to adopt a broader view of EPs to resolve the controversy between the “win-win” and “trade-off” perspectives, and to identify where resources are best spent in developing EPs. To address these issues, this study examines whether or not a more comprehensive set of EPs is associated with improved financial performance.

## **METHODOLOGY**

### **Data Collection**

As indicated in the literature review, previous research efforts have tended to examine a limited range of EPs within several research efforts. From the literature and the researchers’ experience in working with firms, it is apparent that a wider range of EPs

exist. Further, these EPs can be classified as operational, tactical or strategic, depending on their scope. Thus, the research team developed a list of EPs, based on the review of the literature and the researchers' experience with firms' environmental initiatives. This list of EPs is not meant to be fully comprehensive, but is meant to capture the majority of ways in which firms can demonstrate their use of EPs. The list of EPs appears in Appendix 2. This list was then developed into an "Environmental Practices Matrix" (see Appendix 1) for use in a content analysis. This matrix consists of environmental practices grouped into three categories: tactical, operational, strategic practices. As can be seen in Appendix 1, each EP has a column for objective measures of the attribute and intensity of use of the attribute. An additional field was used to indicate if the firm noted any measurements of the EPs (e.g., tons of paper recycled, resources allocated spent, etc.), how involved the firm was with the EP, and where in the environmental report the EP could be found.

The unit of analysis in the data collocation was the firm. A list of potential firms was drawn from four sources. The first was an advertisement that appeared in the Wall Street Journal. In the advertisement, firms asked for additional research into proposed more stringent environmental regulations, while identifying themselves as being environmentally concerned. The second source was a 1993 Fortune article on most improved environmental performers. The third source was "Global Environmental Management Views" (Krut and Drummond 1997). Lastly, the research team relied upon their own experience to determine other leading firms in the field of environmental management. This yielded a list of 94 potential firms. The resulting sample contained a mix of U.S. and international firms.

Data were gathered from corporate environmental reports from the web sites of the sample firms. The web page version was chosen over the printed version in order to gather the reports expeditiously. Comparison of hard copy and web reports from a subsample of companies revealed no substantive differences in the content of the reports. Using "site map" features found on the web pages and a checklist, the research team ensured that the complete environmental report was printed out for each firm.

There were several reasons for using a self reported data source (i.e. corporate environmental reports) rather than a survey based data. The nature of the phenomenon under investigation, its novelty, and the paucity of previous empirical research call for qualitative data analysis techniques such as content analysis (Miles and Huberman 1994). The use of content analysis for gathering data in this study was also due to the decreasing survey response rates the research team has observed. The content analysis methodology was also compatible with the exploratory nature of the study, which is aimed at developing hypotheses linking environmental practices and performance measures.

Content analysis was performed using four student raters. The students attended a training session in which they were briefed on the objectives of the research and trained to fill out the coding sheets used for data collection. The researchers explained the coding process for a sample firm. Raters were given a list of definitions and a coding matrix for each firm studied. See Appendices 1 and 2 for the definitions used and coding matrix. These documents were given to the raters as a guide to what they should look for in rating each firm's involvement with the listed EPs. Data for each environmental practice was captured on a five point Likert scale, with 1 representing a low intensity of involvement with the practice, and 5 representing a high intensity of involvement. Following the training sessions, raters completed a coding sheet for each firm's corporate environmental report. These were reviewed by the researchers for completeness and the coded data were entered into a database.

The corporate environmental reports were coded over a period of four weeks. Raters were asked to re-rate the first few reports again, after they got through all of the reports. This was done to ensure consistency in their ratings. Inter-rater reliabilities were calculated for each of the three planning levels. Standardized item alphas across the four raters are listed in Table 1. As can be seen, they are all quite high, with an average inter-rater reliability of .91. The reliabilities are within the levels normally considered acceptable (Nunnally 1978).

Additional information such as return on investment, sales growth, return on assets and operating earnings was gathered independently of the content analysis using Compustat and World Scope databases. Sales growth was measured as the percentage increase in sales from the previous year.

## Analysis Methodology

Our proposition posits a significant relationship between EPs and internal environmental and external performance measures. The underlying theory supporting this proposition is based on the results of previous research and the resource based view of the firm (Wernerfelt (1984), Russo and Fouts (1997), Starik and Rands (1995), and Klassen and Whybark (2000)). The objective was to test the relationship between two sets of metric variables with set X corresponding to EP dimensions and set Y corresponding to performance dimensions. Testing this type of hypothesis can be done via multivariate regression techniques such as canonical correlation and set correlations.

When considering the application of multivariate statistical techniques, Hair, Anderson, Tatham and Black (1994) recommend canonical correlation analysis when the variables being analyzed can be classified as dependent and based on some theory; the objective of the research is to explore several dependent variables in a single analysis; and the variables measured are metric.

Set correlation provides an alternative to canonical correlation analysis and a single general framework for the study of association and it partitions the variance in terms of the original variables (Cohen and Cohen, 1983). This type of analysis provides three basic measures to test the strength of the relationship. The interpretation of the first measure,  $R^2$ , is similar to that of used in the

multiple correlation analysis. The second measure, the  $p$  value, shows the significance level. The definition of the third measure, shrunken  $R^2$ . Although one may determine from a sample  $R^2$  and the associated significance level that the population  $R^2$  is not zero, it is nevertheless not true that the sample  $R^2$  is a good estimate of the population  $R^2$ . The population estimate is necessarily smaller than the upward biased sample  $R^2$  and thus is often referred to as the “shrunken”  $R^2$ . The magnitude of shrinkage will be larger for small values of  $R^2$  than for large  $R^2$ , other things being equal. Shrinkage will be larger as the ratio of the number of variables to the number of cases increases.

## RESULTS

After reviewing the data, a smaller set of EPs was chosen for examining their relationship to performance. This “filtering” was done to concentrate the analysis on those EPs which these firms were using the most as indicated by the intensity of the use scale. Only those practices that were coded by the raters as having a score of 3.0 or greater on the 0 to 5 Likert scale, were used in our analysis. This value was used as a cutoff since it was at the middle of the rater’s intensity scale and would suggest the firms reporting those EPs are more involved in the actual adoption and execution of these practices than firms rated at a lower intensity.

In the operational practices category, seven practices were identified: recycling, proactive waste reduction, reactive waste reduction, remanufacturing, consume internally, market for waste, and money spent on environment. Eight practices were identified under tactical practices: early supplier involvement, environmental standards for suppliers, environmental audits for suppliers, environmental awards, life cycle analysis, environmental design, specific design target, and environmental risk analysis. There were five strategic practices: corporate policy, environmental mission statement, environmental department, surveillance of market, and strategic alliance.

The output (set Y) measures used in the analysis came from the literature. As discussed earlier, Porter and van der Linde (1995) presented the argument of “innovation offsets.” This argument stated that the innovations caused by environmental regulations would more than offset the cost of complying with the regulations. As a measure of innovation, the research team used the following two constructs:

*Product Innovation:* This item measures how well the firms have done in introducing product innovations and whether they are actively investigating product innovations.

*Process Innovation:* This item measures how well the firms have done in introducing process innovations and whether they are actively investigating process innovations.

In order to measure the impact EPs have on financial measures, the following variables were used:

*Return On Investment (ROI):* This is an objective financial performance measure that is a reflection of overall firm financial performance.

*Sales growth:* This item was measured as the percentage increase in sales from the previous year.

These 20 EPs, comprising the set of independent variables, and four dependent variables (product innovation, process innovation, ROI and sales growth) were entered into the set correlation analysis. The steps for stepwise set correlation include the following:

- (1) All 20 independent variables were assumed to be significant and put into a group referred to as “sig”.
- (2) The independent variables in the group “sig” and the performance (dependent) variables were entered into the set correlation analysis.
- (3) Those independent variables found to be non-significant were removed from sig group and put into a group labeled “non-sig”.
- (4) Repeat (2) and (3).
- (5) The independent variables in group “non-sig” and dependent variables are entered into set correlation function. Those significant independent variables are removed from “non-sig” group and put into “sig” group.
- (6) Repeat (2)–(5) until there are no membership changes between group “sig” and “non-sig”.

There were six independent variables left in the “sig” group when the end of the iterations was reached: recycling, proactive waste reduction, remanufacturing, environmental design, specific design target, and surveillance of market. These six environmental practices were shown to have statistically significant impact on impact the four performance measures. A description of these six items, statistical results and discussion of their impact follows.

In our sample, the overall association, as measured by the  $R^2$  value, between the sets corresponding to EPs and performance dimensions is strong, positive, and statistically significant ( $R^2 = 0.864$ ,  $p = 0.000$ ) with some shrinkage, which was expected due to the number of cases and variables (shrunken  $R^2 = 0.710$ ). All six significant independent variables corresponding to EPs are significant in explaining the covariance in the dependent variables corresponding to the performance measures. In the significance tests for prediction of each dependent  $y$  variable, the significance probabilities for the six independent variables are all below .02, which is lower than traditional cutoff value of .05. The probabilities for independent variables are shown in Table 2.

In this set correlation model, there are 24 linear relationships we are estimating with six independent variables and four dependent variables. Among these 24 relationships, 13 have significance probability values lower than .05. The probabilities for betas are shown in Table 3.

Our sample size of 45 satisfied the low end of sample size requirement: 4-5 observations per variable (Hair et al. 1994). To check for small sample size bias, a stability analysis was performed. The results of the stability analysis are shown in Table 4. Canonical loadings are consistent when independent variables are deleted one at a time and is a good indication of the absence of sample bias (Hair et al. 1994).

## DISCUSSION

The analysis indicates that EPs have a positive and significant relationship with firm performance measures such as ROI and sales growth. EPs explain about 71% variance in performance in the analysis. This is a very strong correlation between the two sets of variables. This finding is consistent with Porter and van der Linde's (1995) argument for innovation offsets and Klassen and Whybark's (2000a) analysis of advanced manufacturing techniques, the environmental portfolio, and environmental performance. Porter and Van der Linde argued that external pressures such as environmental regulations lead to innovations that offset and may exceed the cost of complying with the regulations. Through set correlation analysis, this study's exploration of the relationships between performance variables and environmental practices reveals insight to potential innovation offsets and practices related to improved performance.

The results show that for each performance measure, at least two EP measures are significant. For example, product innovation is significantly related with recycling, remanufacturing, design, and surveillance of the market. The impact of these variables on product innovation is reasonable given the forward looking approaches of firms involved in environmental design and surveillance of the marketplace for ways to reduce waste, or recapture materials through practices such as recycling and remanufacturing. Product innovation and the capability to reduce waste and recapture materials may be a unique resource that helps the firm's performance in accordance with the resource-based view of the firm (Russo and Fouts 1997).

Process innovation was found to have significant relationships with waste reduction and design goals. These relationships are also reasonable given an association between process innovation resulting in waste reduction found by Florida (1996), and the use of process innovation as a complementary asset moderating the relationship between environmental best practices and cost advantage (Christmann 2000).

The relationship between ROI and recycling, remanufacturing, design, and design goals provides insight into the benefits of recapturing materials that would have ended up in a landfill before the use of environmental practices such as design for environment.

This study's findings show that sales growth is significantly related to recycling, remanufacturing, and surveillance of the market. Support for this relationship is found in the experience of firms that share information about recapturing of materials through recycling and remanufacturing.

With economics being one of the driving forces behind company decisions and actions in environmental affairs (Dillon and Fischer 1992), the significant EPs for each performance measure are suggestive of specific environmental programs firms should utilize in pursuit of enhanced performance objectives. For example, a firm that wants to increase ROI should emphasize such EPs as recycling, remanufacturing, design and specific design goals. Firms interested in sales growth should emphasize recycling, remanufacturing, and surveillance of the market. A higher percentage of products that use environmentally conscious design practices will help reduce the cost in later stages of environmental practices such as recycling and waste reduction, so this should also lead to increased profits. This relationship is indicated by the significant relationship between ROI and design. Environmentally conscious design practices emphasize formal scheduling of environmentally conscious design practices. This is indicated by the significant relationship between ROI and specific design goals. These results affirm Porter and van der Linde's (1995) suggestion that a proactive approach is better rewarded than a reactive approach to environmental regulations.

Looking at each of the six significant EPs, one can examine what effects each one has:

- (1) *Recycling*: This item measures whether firms do recycling or not and for how long. Recycling is significantly related with product innovation, ROI, and sales growth. Recycling is a significant predictor for the set of performance measures with a p value of .018. Recycling helps with cost savings via more efficient use of materials, therefore ROI is enhanced. Recycling also improves firm image, which can help to improve sales growth.
- (2) *Waste Reduction*: Waste Reduction measures the degree of *proactive* approaches to reducing waste in processes and or the elimination of waste before it is produced. Waste reduction (p value of .001) is significantly related with the *set* of performance measures, however, it is only individually significantly related to the process innovation. Perhaps this is an indication that waste reduction might be better engendered by process innovation rather than product innovation. It can be argued that process innovation usually has a longer lead-time than product innovation. This might explain why it is not related to either ROI or sales growth in this study.
- (3) *Remanufacturing*: This item is defined as the degree to which the firm rebuilds a product where some of the parts or components are recovered or replaced. Remanufacturing is significantly related with the same three performance measures as recycling: product innovation, ROI, and sales growth.
- (4) *Environmental Design*: This measure is concerned with the percentage of products that use environmentally sensitive design processes. Results indicate environmental design is significantly related to product innovation and ROI. This is in line with Porter's idea of innovation offsets, as it may be the case that using environmentally sensitive design processes does in fact result in greater product

innovation and thus higher ROI. A test of this specific causal relationship using some type of path analysis would be an excellent topic for future research.

- (5) *Specific Design Goals*: Quantitative environmental design goals were significantly related to process innovation. While there has certainly been a great deal of literature about process innovation, such as the entire line of research spawned by the reengineering concept (Hammer 1990), these findings may shed new light how to make process innovation happen. Specifically, our results indicate that the potential cause-effect relationship between specific environmental design goals and process innovation bears further investigation. To a certain extent, the results suggest a formalized approach to design goals will have favorable results and support similar findings by Sroufe, Curkovic, Montabon, and Melnyk (2000).
- (6) *Surveillance of the Market for Environmental Issues*: This measure identified those firms that look for opportunities in the future related to environmentally friendly practices. The results indicate that a proactive approach to this EP is significantly related to product innovation and sales growth.

The results of the set correlation analysis indicate EPs is a multidimensional construct. Typical views of EPs are much narrower, typically only involving the "3 R's" (Timmins 1998) of reduction, reuse and recycling.. This analysis shows that EPs go far beyond recycling and waste reduction and encompass such activities as remanufacturing, environmental design, design goals, and surveillance of the market for environmental innovation. The results show that EPs do have a strategic impact on a corporation, which should be of interest to firms considering whether or not environmental programs or investments should be pursued. Results show that adopting EPs can lead to improved performance.

## LIMITATIONS

There are some limitations inherent in content analysis. One of the primary weaknesses in this regard is the lack of standards for environmental reporting. Though many of the reports used in this study followed a similar format, there is no standard way of releasing this information (in direct contrast to the financial reporting required by the SEC and FASB). Thus an intuitive direction for future research would be to use "standardized" measures of EPs. However, there is a lack of such measures covering all of the EPs defined in this research, which makes it difficult to utilize standardized measure of EPs.

## CONCLUSION

This study contributes to the existing literature through more comprehensively defining EPs while demonstrating how environmental management and environmental business practices are related to performance. The results presented in this paper confirm findings from previous empirical research. In particular, this study empirically examined the relationship between Environmental Practices and firm performance in order to see if the "win-win" argument of Porter is supported. Using corporate environmental information, content analysis, and multivariate data analysis, the results show that firms in the study use a wide range of EPs and that these practices are positively associated with multiple firm performance measures.

The results of this study indicate that some environmental practices which have not been emphasized in environmental management field before are significantly associated with firm performance. From a practitioner's standpoint, it demonstrates the spread of environmental practices, and for researchers, highlights the need for examining a comprehensive set of environmental practices, rather than a limited set of techniques. In particular, future research should examine a wider set of EPs, with an eye towards examining how and why EPs lead to performance.

References, Tables and Appendices available upon request from the authors.

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